

## Commodity Chain of Frankincense from the Dry Woodlands of Nuba Mountains, South Kordofan State, Sudan

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**Abstract** Frankincense is one of the major commercial NTFPs in the Sudan produced by tapping the bark of *Boswellia papyrifera* (Del.) Hochst trees. It is one of the major NTFPs of the Sudan traded locally and internationally. The aims of the present study include: (1) to identify the chain actors and their functions (2) to estimate benefit distribution and value added along the chain; and (3) to determine the mechanisms by which actors control and maintain access to benefits. The study was conducted in the Rashad locality, South Kordofan state, Sudan in 2008/2009. A combination of Rapid Rural Appraisal tools including key informant interview, in-depth semi-structured interviews, group discussion and direct observations were used for primary data collection. Eight major actors involved in the value chain were identified and their activities and characteristics examined. The average annual net income of tapper, producer, village trader, and urban merchant was estimated to be 74, 740, 1,300, and 11,230 USD, respectively. The results clearly demonstrate the upward skewed benefit distribution among the value chain actors. The total relative commercialization margin was 62.5% indicating that the actors involved in marketing of the product accrued higher proportion of the end market price. While those involved in the production activities, tappers and producers, receive less income counting about 37.5% of the end market price. The results also illustrate that there is limited value added processing in the commodity chain. Commercial

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benefits in the commodity chain are gained, maintained and controlled through different mechanisms. The study concludes that frankincense production and marketing is financially profitable for producers, village traders and urban merchants. However, frankincense tappers and producers receive less income. Technical, financial, and institutional support could result in an increase in local actors' income and contribute to sustainability of the supply of the product.

**Keywords** Frankincense · Actors · Benefit distribution · Value added · Commercialization margin · Access mechanisms

## Introduction

The forests and woodlands of Sudan are potential source for large number of Non-Timber Forest Products (NTFPs) that support the livelihoods of rural community living in and around the forest areas as well as the national economy. The various NTFPs extracted from the woodlands of the country are consumed, traded locally for a variety of uses and/or exported to international markets. In this regard, gum arabic is an important source of foreign exchange for the country. Sudan earned more than 100 million USD in 2006 and 2007 from the export of gum arabic (CBOS 2006, 2007), accounting for about 10% of the annual non-oil export income. Other important NTFPs with international markets include Gum *luban* or olibanum from *B. papyrifera* which generated 153,000 USD in the year 2007 alone (CBOS 2007). The majority of the frankincense/olibanum produced in the country is consumed internally and therefore only a limited proportion is exported.

*Boswellia papyrifera* is among the dominant natural gum and resin bearing tree species in southern Sudan, covering large areas in the south of the traditional gum belt. The species occurs as a pure stand or mixed with other species such as *Sterculia Setigera*, *Combretum* Spp., *Terminalia* and *Commiphora* species on slopes and land hills (Salih et al. 2002). The area covered by *Boswellia* woodland is believed to be a very large portion of the country. *B. papyrifera* is known for its diverse ecological and economic benefits (Chikamai 2002). It is a multipurpose tree species almost all parts of the tree are used for different purposes. Its wood is used for pole and timber. The sweet smelling flowers, that appears when the tree fall its leaves, are important sources of nectar for honey bees (Fichtl and Admasu 1994).

The leaves and seeds are highly valued as dry season fodder for goats, camels and other livestock (Tilahun 1997; Adam 2003; Gebrehiwot et al. 2003). The leaves, bark, root and the resin are also used as traditional medicines for curing various diseases (Tucker 1986; Azene et al. 1993; Eshete et al. 2005). In economic terms, frankincense or gum olibanum is the most valued product of the tree species, as it has wider applications for cultural uses and modern industries (FAO 1995) and source of employment and cash income.

Frankincense or olibanum is the hardened, resinous wood exudate obtained from *B. papyrifera* by making incisions in the bark with a special tool called '*Mingaf*' (FAO 1995). The word frankincense is derived from the old French word '*franc encens*' meaning "pure incense" (Tucker 1986). Although it is better known as

“frankincense” the resin is also called *olibanum*, which may be derived from the Arabic ‘*al-lubān*’ (roughly translated: “that which results from milking”), a reference to the milky sap tapped from the *Boswellia* tree. Detail account on the chemistry of frankincense is given in Tucker (1986). It is composed of about 5–9% essential oil, 65–85% alcohol-soluble resins, and the remaining water-soluble gums. The essential oil extract from the resin obtained by steam distillation has wide applications in traditional medicine, perfumes and fragrances, aromatherapy, pharmaceuticals, as flavour in the food and beverage industries, for making adhesives, chewing gum (FAO 1995). Unprocessed frankincense is commonly used in cultural and religious ceremonies. Frankincense, along with gold and myrrh, was presented to the newborn Jesus Christ. This resin is widely used as incense in Sudan and the surrounding countries including the Middle East and in many churches worldwide.

Frankincense is an ancient commercial forest product which currently remains an important commodity. Ethiopia, Eritrea, Kenya, Somalia and Sudan are the major producers and exporters of frankincense (Chikamai 2002). In addition to its environmental benefits, the production and marketing of frankincense offer diverse socioeconomic benefits at local, regional and national levels, including job opportunities and remarkable economic benefit for tappers, traders, exporters, and the national economy at large. Its contribution to the national economy is reflected in its status as one of the forestry export commodities.

More than 3,700 metric tonne of frankincense was exported from Sudan between 2000/2001 and 2006/2007 with the value of export more than 3.5 million USD from this export in the respective years (CBOS 2006, 2007; Ministry of foreign trade annual reports). However, despite the good resource potential of *Boswellia* stands in the country, its share of the market remains relatively small with regards to its resource potential (Salih et al. 2002). Rashad Locality is the major frankincense production area in South Kordofan. El Tahir and Gebauer (2004) estimated that the Rashad Locality has an average annual production potential of 8,000 tonne.

Despite the potential for socio-economic and environmental benefits from the utilization of the resource, not much has been done to analyze the production and marketing systems of frankincense in the study area. Data from such studies is crucial for policy making to ensure the development and conservation objectives through commercialization of the product. Thus this study aims to: (1) identify and characterize the chain actors, their functions and interaction; (2) estimate benefit distribution and value added along the chain; and (3) determine the mechanisms by which actors control and maintain access to benefits.

## Theoretical Framework

### Commodity Chain Analysis

The commodity chain framework (Ribot 1998; Gereffi et al. 2001; Kaplinsky and Morris 2001) was used as its theoretical base in this study. It is an analytical tool which helps to examine the activities in the production line, trace the value added at

each stage as the product moves along the chain, and explain the structure and mechanisms that enable different actors to benefit from a certain resource or activity. A commodity chain is a series of interlinked exchanges through which a product and its constituents pass from extraction or harvesting through processing and marketing to its end use (Ribot 1998; Sturgeon 2001). It encompasses the whole range of activities involved in the production-to-consumption system of a given product focusing on the value added, the integration of the actors and power relations (Kaplinsky and Morris 2001; Marshall et al. 2006; Schreckenberg et al. 2005).

Lair (2006), in his extensive review of the application of commodity chain analysis, indicates that the concept of commodity chain was first put forward by Hopkins and Wallerstein in the mid-1980s. It was later modified by Gereffi in 1994 who termed it a global commodity chain (GCC). Although it was initially developed for the analysis of industrial products, its application for agricultural commodities was later recognized. Chains which composed of actors and their activities that interact to supply goods and services are varyingly referred to as ‘production chain’, ‘commodity chain’, ‘supply chain’, ‘value chain’, ‘activities chain’ and ‘pipeline’ (Gereffi et al. 2001; Sturgeon 2001). These concepts often overlap, making it difficult to make fine distinctions between them. They all describe the interactions of firms and processes that are needed to deliver products to end users, and they all aim to identify opportunities for, and also constraints of, increasing productivity. However, they mainly vary in focus, in the activity that is emphasized, and in the way in which they have been applied. For example, ‘supply chain’ is favored by economists to highlight the issue of competitiveness, while sociological literatures tends to use ‘commodity chain’ and ‘value chain’ when examining relationships between actors (Ribot 1998; Gereffi et al. 2001; Sturgeon 2001). Alternatively, when products are traded or different segments are performed internationally, the term global commodity chain or global value chain is used (Gereffi et al. 2001).

The commodity chain approach examines the key actors and their functions in the chain in order to analyze the relationships between them and the factors affecting the performance of the chain (Kula et al. 2006). Thus it emphasizes three elements, namely actors, factors and relationships that determine the outcomes of the chain. Factors include access to and the requirements of end markets, the global, national, regional and local business enabling environments, vertical linkages between actors that permit the flow of products and services, learning and benefits, horizontal linkages, support services, and opportunities for upgrading. The relationship component also includes the power dynamics, distribution of benefit and access to learning and innovation.

### Theory of Access

The Ribot and Peluso’s (2003) “Theory of Access” is used as a theoretical base for examining the power relation in commodity chains. Property rights are key institutional characteristics that determine the use of resources and influence the behavior of the resource users. Access theorists argue that property is not only necessary, but access is also essential in the derivation of benefits from the resources

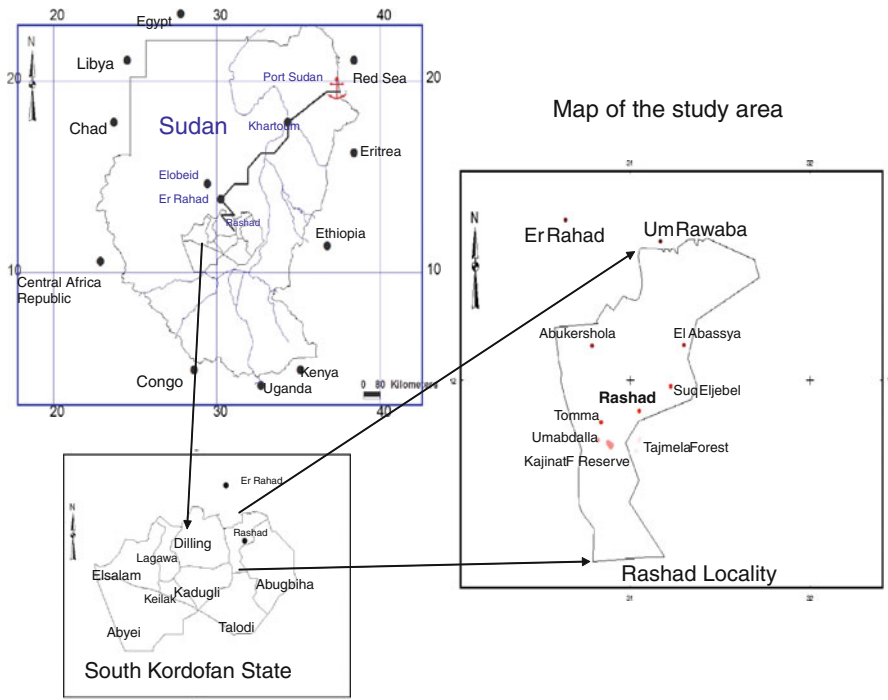
in question. Access is regarded as ‘the ability to benefit from things’ (Ribot 1998; Ribot and Peluso 2003). This is broader than property’s definition as ‘the right to benefit from things’. Access includes both *de jure* and *de facto* mechanisms governing resource use as opposed to property which is *de jure*. According to the ‘theory of access’, access is viewed as a ‘bundle of power’ as opposed to the conventional approach which denotes property as a ‘bundle of rights’ (Ostrom and Schlager 1996). In addition to property rights, there are also a number of important factors that mediate the process by which benefits are acquired, controlled, and maintained with regards to natural resources. Ribot and Peluso (2003) employ structural and relational access mechanisms that influence benefits from a given resource, including infrastructure, access to technology, capital, markets, labor, knowledge, authority, identity, and social relations (Ribot and Peluso 2003). They argue that the access approach is more helpful for analyzing how different actors generate benefit from the things whether or not they hold the right to them. Access mapping along a commodity chain (Ribot 1998; Ribot and Peluso 2003) illustrates the distribution of benefits and the mechanisms, structures and processes that lead to the control and maintenance of access to benefit which is a function of a power relationship. These mechanisms can be divided into access control and access maintenance, where access control denotes the ability to mediate other’s access while access maintenance requires expending resources or power to keep a particular sort of resource access open (Berry 1993 cited in Ribot and Peluso 2003).

## The Study Area

The study was conducted in the Rashad Locality (Fig. 1), located in the Nuba mountains region, Southern Kordofan State, approximately 680 km from the capital Khartoum. South Kordofan (*Janub Kordufan*) State is one of the 26 states and it is almost centrally located in the heart of Sudan. Geographically it is situated between 10° and 13° N latitude and 29°–33° E longitude, covering a total area of about 141,096 km<sup>2</sup> (El Tahir and Gebauer 2004). The analysis started from Tomma village where the commodity is produced and the chain of actors and their activities are identified and analyzed following the chain up to the central market.

Based on geographical features, South Kordofan State is broadly divided into four main regions: the Nuba Mountains, the eastern plains bordering the White Nile, the southern plains bordering Bahr El Arab, and the western sandy plains. The Nuba Mountains Range covers an area of about 5,000 km<sup>2</sup>. In the region, the hills reach an altitude of more than 1,000 masl. The climate of Rashad Locality is sub-humid with annual rainfall ranging from 400 to 800 mm per year that extends from mid-May to mid-October allowing grazing and seasonal rain-fed agriculture.

The region is known for its diverse flora especially commercial gum and resin bearing tree species principally *Boswellia*, *Commiphora* and *Sterculia* species. The vegetation cover, as described in FAO (2008), is typically low rainfall woodland savannah. The species composition in the area varies considerably based on soil types. In the rocky hills with sloping ground and shallow soil various species can be found, including *B. papyrifera*, *S. setigera*, *Lonchocarpus laxiflorus*, *Combretum*



**Fig. 1** Map of the study area, Rashad locality in South Kordofan state, Sudan

*harmannianum*, *Terminalia brownii*, *Anogeissus leiocarpus*, *Stereospermum kunthianum*, *Oxytenanthera abyssinica* (lowland bamboo), *Adenium* spp. and *Pterocarpus lucens*. A hard surface zone frequently occurs at the base of the hills. Here, *Acacia nubica*, *Lannea humilis* and *Sclerocarya birrea* are characteristic species. *Hyphaena thebaica* occurs on more permeable soils. Along seasonal watercourses *Acacia albida*, *Ziziphus spina-christi*, *Cordia abyssinica* and *Khaya senegalensis* are found. Owing to the diversity of species, the area is known for its potential for providing varieties of NTFPs (El Tahir and Gebauer 2004).

The population of Rashad locality was estimated at 241,046 in 2002 (UNDP 2003), and the annual population growth rate was 1.38% (UNDP 2003). The conflict in 1985 and its escalation in 1990s led to widespread destruction of traditional sources of livelihoods and massive internal displacement in the area. The three main livelihoods in the study area include agriculturalists and minor livestock holders, the pastoralists, and the town/urban groups (NMPACT 2002). In addition, NTFPs contribute to household income in Nuba Mountains (El Tahir and Gebauer 2004), and are the only source of income during the dry season which is used for paying for food as well as for water, education, and medications (UNDP 2003; Hassan 2005). Prior to the conflict in Nuba Mountains, local-level trade accounted for approximately 20% of the livelihoods in the region (UNDP 2003). Opportunities for trade opened up with the signing of Comprehensive Peace Agreement (CPA) in the

country between the government of Sudan and Sudan People's Liberation Movement/Army (SPLM/A) in 2005, which facilitated free movement in the region.

## Research Methods

### Research Approach

This study employs a case study approach (Yin 1994) for the exploration of the commodity chain. Starting from the villages producing the commodity, the chain of actors and processes was traced to the final domestic and export markets in the country. The unit of analysis was the chain consisted of actors at different levels in the commodity chain that extends from the production areas to export market through different processes. A mixed approach for the case study methodology is appropriate as commodity chain analysis is an explorative study that needs multiple sources of evidence for an in-depth understanding of the whole process, outcomes and its components along the commodity chain. In addition, some estimates of production and incomes are presented based on secondary data and interview with actors operating at regional and national level in order to give an overview on the distribution of benefits along the commodity chain and contributions to the national economy.

### Data Collection

Qualitative and quantitative data were collected from relevant sources using a combination of different Rapid Rural Appraisal (RRA) tools. Secondary data was collected from Forest National Corporation (FNC), local authority offices and Central Bank of Sudan (CBOS) annual export statistics. Key informant interviews were conducted with people who have first hand information about the production–consumption system of frankincense to gain a general overview of the production and marketing of frankincense in the study area and for the initial mapping of the chain. A total of eight key informant interviews were conducted with Rashad FNC officer ( $n = 1$ ), tribal leaders ( $n = 2$ ), researchers in Elobied Agricultural Research Station ( $n = 2$ ), and experienced frankincense traders ( $n = 3$ ). The information from key informants enabled the preliminary identification of the different nodes (e.g. tapping and collection, processing, marketing both intermediaries and wholesale) and the actors directly involved in the frankincense commodity chain. Secondary data on production, marketing, tax and other fees, and related issues were also collected from different offices including Rashad locality FNC office, Locality finance office, Ministry of foreign trade, customs authority, Elobied Agricultural Research Station.

A total of 34 semi-structured interviews were conducted with commodity chain actors (frankincense tappers = 7, producers = 8, village traders = 8, urban merchant/processors = 3, wholesalers and retailers for domestic market = 7, and exporter = 1) to gather primary data on production, processing and marketing aspects. Two group discussions were held in two villages with village committee,

tribal leaders and local community members. The focus of the discussion was production of frankincense in the village, resource access, the status of *Boswellia* woodland, benefits of *B. papyrifera* to the community and the impact of the frankincense production on the resource base. Moreover, direct observation of the production activities in the forest, marketing in four market places and processing in three processing firms was made. This non-participant observation, watching the situations openly, provided truthful information that is further used to check the information collected through interview especially on sensitive issues such as price and benefit. The combination of different methods and multiple sources used in the study enables triangulation of the collected data to ensure the reliability and validity of the results.

### Data Analysis

Qualitative and quantitative analyses methods were employed to analyze and present the data. Commodity chain analysis (Ribot 1998; Kaplinsky and Morris 2001; Marshall et al. 2006) was applied for the analysis and presentation of data that entails:

- Mapping and description of the commodity chain-graphic presentation of the different actors involved in the chain and their principal activities;
- Quantifying the physical flow, value added and distribution of benefit along the chain.
- Access mapping and presentation of mechanisms, including the identification and presentation of the different mechanisms used by actors to gain control and maintain access to benefit.

Quantitative data on the cost and revenue structures, value added, benefit distribution were analyzed are calculated using the expressions briefly described by Marshall et al. 2006.

Profit margin at each stage was calculated to evaluate the benefits along the commodity chain, as:

$$\text{Profit margin} = (\text{Revenue} - \text{total cost})$$

where Revenue = sale volume  $\times$  unit price

$$\text{Profit margin \%} = \frac{(\text{Revenue} - \text{total costs})}{\text{Revenue}} \times 100$$

Commercialization margin were calculated as indicator for the distribution of benefit along the chain which shows the proportion of the consumer's price received by a given actor. In this study, the end market price at national level that is domestic retailers price was used for the estimation of commercialization margin.

Commercialization margin

$$= \frac{(\text{Difference between sale and purchase price of the product})}{\text{Consumer Price}} \times 100$$



Value added is a central concept in the traditional value chain analysis. As a given commodity flows through the different segments along the chain, value is created. Value added is the difference between revenue and the cost of externally sourced material and service inputs is a node's value added (Klemperer 1996; Tallec and Bockel 2005). It differs from net profit by wage costs, depreciation, and corporate overhead including marketing expense, interest, and taxes. As presented in Tallec and Bockel (2005), value added is not only an element of income but also represents the distribution of that income among the fundamental agents of the national economy, including households (the recipients of the return to labor), financial institutions (interest charges), government administration (taxes), and enterprises (gross or net profit). Value added gained at each stage along the chain as the commodity flows through each respective stage was estimated using the following expression as per Klemperer (1996) and Tallec and Bockel (2005).

$$VA_i = Y_i - \Pi_i$$

where  $VA_i$  = Value added at the  $i$ th stage;  $Y_i$  = output from segment/stage  $i$ ; and  $\Pi_i$  = intermediate material and service input from outside the chain excluding the product from the previous stage, used in stage  $i$ . From the perspective of distribution value added was estimated as:

$$VA_i = \text{profit} + \text{tax} + \text{wage}$$

The value added in the entire chain (VA chain) is calculated as the amount obtained by the summation of the VA of each node or stage along the chain.

$$VA \text{ chain} = \sum_i VA \text{ nodes.}$$

## Findings

### Functions Along Frankincense Commodity Chain

The frankincense commodity chain in the Rashad Locality has three functional segments, namely production, processing, and marketing or distribution that includes trade in rural, urban and central markets by local traders, wholesalers and retailers, and exporters. Their detailed description is presented as follows:

#### *Production*

Production of frankincense involves tapping *Boswellia* trees, collecting dried resin from the tree, and drying and packing, after which the product is transported to the nearest rural market. The actual production is performed by the tappers; the functions of the producers are to obtain production licenses and supplying the tappers with production materials and subsistence needs in the form of a loan. Producers and tappers indicate that on average 60–80 kg of frankincense is produced from one hectare which is less than the estimates by Ali (2004)

100 kg ha<sup>-1</sup> in the same study area. This could be attributed to the declining density of *Boswellia* trees in the woodlands and lower productivity as a result of continuous production. Yield of frankincense from a given area is actually dependent on several factors such as the density of trees, climatic condition like temperature, site condition (soil, slope, altitude and aspect), tapping intensity and frequency, and the variety of the species.

### Marketing

The frankincense produced in the study area is marketed at rural, urban and central markets and different actors are involved. The product enters the rural market where it is collected by village traders and other middlemen. Then, the village traders and the middlemen transport the product to urban market and central market. The main players at rural markets are local traders and producers. The producers traditionally display their products and negotiate prices with local traders. Selling takes place upon the agreement between producers and local traders where price is declared by the traders after receiving signals from central and urban markets. Rural markets in the locality are operational on a weekly basis and therefore local traders can attend different markets within a week. Taxes and local duties for frankincense trading are collected at the rural markets when the product is trucked from the market. The product is trucked from rural to urban markets where it is delivered to urban merchants; frankincense is traded at major urban markets such as Um Rawaba and El Rahad. The different taxes and duties collected by different government bodies at rural and urban markets are presented in Table 1.

### Processing

Urban merchants in El Rahad and Khartoum buy frankincense in bulk from local traders and perform processing activities limited to cleaning and grading. Cleaning and grading is performed manually by female labor; this involves removal foreign

**Table 1** Taxes and local duties imposed on frankincense at rural markets

Fees	Amount (USD/quintal)	Beneficiaries	Remark
Royalty fee	2.80	FNC	
Forestry support	0.40	FNC	
Removal fee (vehicle departure)	0.10	FNC	5 USD/lorry
Infrastructure fee	1.10	FNC	
Locality fee	2.20	Locality	
<i>Zekat</i>	4.80	Central government	10% of the value of the product
Finance fee	1.90	Regional state	
Tax	1.10	Central government	
Total	14.40		

Source: Field survey, 2008

**Table 2** Description of the different grades of frankincense

Grade	Proportion (%)	Description
Grade 1/super	15	Big granule size and white color
Grade 2	12	White color and medium grain size
Grade 3	18	White color and smaller grain size
Grade 4 <i>Negawa</i> and <i>Ozala</i>	30	Brown to black color and big grain size (stick together)
Grade 5 <i>Gishra</i> and <i>scartu</i>	17	The bark and some remnant resin not separated from the bark
<i>Turab</i>	8	By-product—the dust remained after separating the other grades

Source: Field survey, 2008

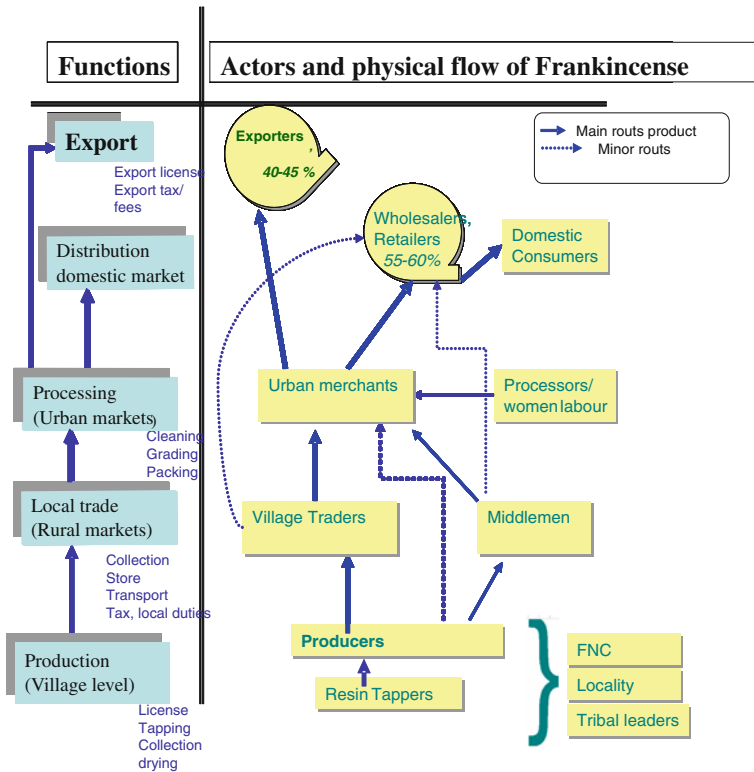
materials and sorting the product into different grades. Once the foreign materials are removed and the large granules that stick together will be crushed to separate the granules. Following this, sieves of different diameter sizes are used to separate the various sizes of granules. Grading is based on color, granule size and purity. Larger and white lumps are valued more than the smaller, powdered and darker ones. In Sudan, five grades of frankincense are recognized. The first three grades which are delivered to export market consist of white granules of different size (Table 2). The fourth grade (*Lagawa and Ozala*) consists of granules of brown or black color of any size. The fifth grade (*Gishra and Scartu*) comprises remnants of resin attached to the bark. The by-product that remains after processing, “*Turab*”, is sold locally and used as a cementing agent for the construction of mud houses. Similar criteria are used for grading frankincense in Ethiopia, which also uses the five grade system (Gebrehiwot et al. 2003).

Processing is restricted to primary processing such as cleaning and grading indicating the absence of significant value-added processing in the country. However, there is potential for value-added processing such as the extraction of essential oil through steam distillation or solvent extraction (FAO 1995).

### Structure of the Frankincense Commodity Chain

The study identifies eight major groups of actors in the commodity chain broadly grouped on the basis of their functions and position in the chain. These includes: the government (Forest National Corporation, tax office, *Zekat*<sup>1</sup> offices); tribal leaders; frankincense tappers; producers or licensees; traders (village traders, middlemen, agents of urban merchants, urban merchants); processors; exporters; and wholesalers and retailers. The simplified chain showing the different actors, their functions and physical flow of frankincense is illustrated in Fig. 2.

<sup>1</sup> A fix portion (10%) of the frankincense production is paid by the producers to government to be distributed to poor people according to the Islamic Principles.



**Fig. 2** Schematic presentation of Commodity chain of frankincense in Sudan

### *The Government*

According to the 1989 Forest Act of the country, all forests and woodlands are state properties managed by FNC. FNC issues production permits and hence all frankincense production activities in the area take place under the FNC approval and supervision. The corporation is theoretically responsible for the management of *Boswellia* woodlands and collect royalty fees from producers and traders at the local level. In addition, the state government collects different forms of taxes and fees from frankincense businesses at different levels through its various institutions such as the tax office, *Zekat* office.

### *Tribal Leaders*

The government administration is represented by tribal systems at local or village levels. Tribal leaders are responsible for controlling social activities in a village and the allocation of land and other natural resources. They play a greater role in regulating the allocation of *Boswellia* woodlands for producers and reconcile resource-use conflicts. FNC use the written agreements between the producers and

tribal leaders as a base for the issuance of production permits. Tribal leaders lease production areas annually to producers and collect resource rents. The allocation is mainly on a competition bases that those who pay higher amount for a unit production area (*Taya*<sup>2</sup>) are able to lease as much area depending on their capacity.

### *Frankincense Tappers*

Frankincense tappers constitute the base of the commodity chain. They are hired laborers operating under producers who hold licenses for frankincense production. They represent the largest group of actors in the chain directly engaged in production. They have the technical skills for tapping and collection of frankincense. Examining the profile of tappers, the study reveals that frankincense production is exclusively done by men with the age group ranging from 29 to 60 years. Most of the tappers in the study area are seasonal migratory workers belonging to Bani-Amir tribe originating from Eastern Sudan. They have experience of 5–24 years in frankincense production. According to Ali (2004), 69% of the tappers engaged in frankincense tapping in the Rashad Locality are migrants from different parts of Sudan. The low-level involvement of local community members could be attributed to the hardships associated with the activity, including: distribution of the resource in ragged terrain and the harsh climatic condition; long distance from their village and time spent away from home; and associated risks like poisonous snakes and malaria. However, in recent years local communities in the area are being engaged in tapping, as result of the income generated by the activity.

Economically, tappers belong to low-income earners group and their primary occupation is agricultural and they depend on frankincense production to supplement their income. Owing to their lack of capital needed to pay for production licenses and resource rent, they work as a hired labour under producers. They are also less educated; most of them only attended '*Khalawa*'.<sup>3</sup> The tappers asserted that frankincense production generates additional immediate cash income that is economically attractive for them, supplement farming income and it is off-farm activity not competing labor allocation with other available household farming activities.

Tapping is conducted by a group of 3–5 tappers in a *Taya* (about 63 ha) depending on the density of trees in the stand. In the 2008/2009 production season about 72 tappers (30.1% of households) were engaged in frankincense tapping in Tomma village on 1,100 ha. Taking the woodland area leased for production and the average number of tappers in a unit production area (4 tappers/63 ha) the number of tappers in Rashad Locality in the same production season was estimated to be more than 828 (Table 3), indicating the contribution of frankincense production in employment creation of many households.

<sup>2</sup> *Taya* (local land area measurement) which equals to 63 ha.

<sup>3</sup> A local traditional institution for Islamic education.

**Table 3** Number and distribution of frankincense producers and tappers in Rashad locality

Sub-circle	Number of producers	Area in ha	Estimated no. of tappers <sup>a</sup>
Rashad and El Moreb	45	6,300	400
Abassya	25	2,646	168
Umlubia	25	2,520	160
Abu kershola	23	1,575	100
Total	118	13,041	828

Source: Rashad locality FNC office and taking average number of tappers

<sup>a</sup> Taking average 4 tappers per *Taya* (63 ha)

### *Producers*

These are license holders for frankincense production. Frankincense production in the area is organized by producers who have established relationships with tribal leaders and local frankincense traders. The investment required in frankincense production is initial capital for leasing production areas, obtaining licenses and to cover costs of production materials and labor. Producers lease production areas from tribal leaders and obtain production permits from the FNC. Most producers are former tappers who grow their business into this position when they gain the financial capacity to afford the initial investment. According to the FNC office, more than 118 producers are engaged in frankincense production annually in the Rashad Locality (Table 3). In Tomma village about 13 producers were involved in the production during the 2008/2009 production season. About 62.5% of the producers are outsiders belonging to Bani-Amir tribes from Eastern part of Sudan.

### *Village Traders*

The frankincense produced in Tomma village is sold at village market and collected by village traders, middlemen and agents of urban merchants. Up to 8 village traders and middlemen buy frankincense in this village market weekly. It is difficult to estimate the number of actors in this segment, as many of the traders enter and exit the commodity chain on the basis of opportunity and many of them are also engaged in trading other agricultural commodities and bring some industrial commodities to rural markets. These groups of actors serve as intermediaries to link the producers to central markets. They collect frankincense from producers in rural markets and to a lesser degree, from production sites. These traders pay all the taxes and duties at rural markets like royalty fees, *zekat*, transportation fees, and locality fees at local level and deliver the product to central markets.

### *Urban Merchants and Processors*

Urban merchants own warehouses in urban centers such as El Rahad, Um Rawaba and Khartoum. They buy frankincense in bulk quantity and perform primary processing that is mainly limited to cleaning and grading. Most of the frankincense

produced in the study area is transported to El Rahad city where three frankincense processing firms are located. The owners of these processing units buy the product from the Rashad Locality and other parts of South Kordofan. The different grades of the product are then delivered to the exporters and domestic wholesalers at central markets directly or through their agents. Some traders also transport the commodity from rural markets directly to Khartoum city where other processing units are located. At this stage women's involvement in the commodity chain appears. Cleaning and grading activities are exclusively performed by female labor.

All three urban merchants are backward integrated in the commodity chain into the lower-level operations. In addition to buying and processing the frankincense produced by other producers, they also organize production through agents in the production areas. Thus, they also perform the producers' function to take the advantage of collecting more than one level income margin in the chain. The urban merchants interviewed in El Rahad assert that they know all the entire production and marketing processes because they being their business as tappers and producers and scale up their business over time.

### *Exporters*

Exporters are foreign traders and agro-business companies which are smaller in number and are concentrated in the capital city and Port Sudan. They possess export permits, pay customs and other taxes to export the commodity to the international market. The first three grades of frankincense which constitute about 40–45% of the unprocessed product are exported. The main importers of frankincense from Sudan include countries in Middle East and Europe, the United Arab Emirates, Saudi Arabia, China, France, Germany, and Italy (CBOS 2007).

### *Wholesalers and Retailers*

Most frankincense produced in Sudan (55–60%), except the first three grades, is used for domestic consumption. Wholesalers buy the lower grades of frankincense from urban merchants in bulk and sell to retailers who then sell it to domestic consumers. These groups of actors own retail outlets in domestic markets and also engage in trading other agricultural and other commodities. Thus, license is not required and fees are not charged specific to frankincense at this level.

### *Revenue Distribution and Value-Added Along the Frankincense Commodity Chain*

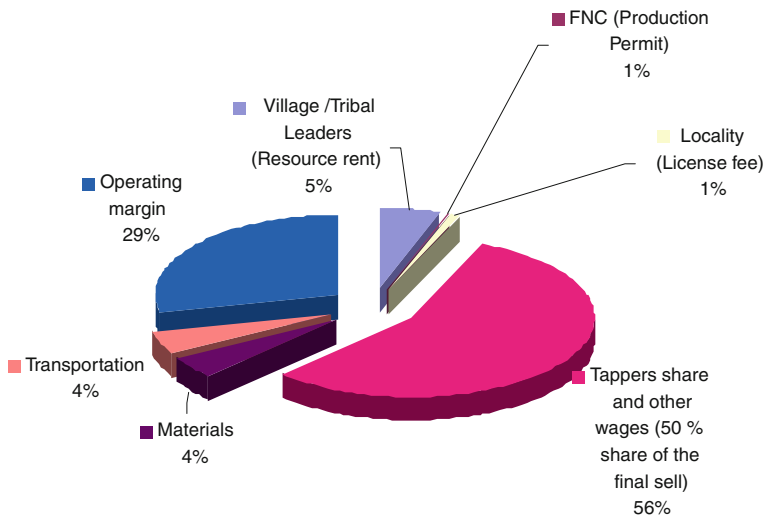
The analysis of the cost and revenues at the producers' level indicates that producers' profit margins are 15 USD/quintal. Using the average production of 4.9 tonne/year, the net income of a producer in one production season is approximately 740 USD per production season which is equivalent to 12 USD ha<sup>-1</sup> making about 28.50% margin (Table 4).

Looking into the distribution of costs at producers' level, labor cost represents the largest amounting to 56% of the revenue. This clearly indicates that frankincense

**Table 4** Producers' cost and revenue structure

Average volume produced by a producer per year	4.9 tons
Cost items. price/income	USD/ year
Operation cost (materials, transportation)	231
Labor cost	1,462
Other fixed costs (license fee, locality fee, resource rent)	165
Subtotal costs	1,858
Average sale price (USD/quintal)	53
Total revenue (average price × average production)	2,599
Profit (revenue less total cost)	741
Profit margin%	28.50%

Source: Authors' analysis based on interview data from producers, 2008

**Fig. 3** Share of costs from the total revenue of frankincense at producers' level

production is a labor intensive business creating local employment. From the producers perspective labor cost constitutes the major investment for frankincense production. License fees for the locality office and the FNC requires 1% each from the total revenue. It is noteworthy that license/production permit fees have a very low share of the total revenue from frankincense production. Furthermore, only 5% of revenue goes to the village or is paid to tribal leaders for the use of the resource. Transportation and material costs together accounts for 8% of the total revenue. The share of the profit margin of the producers is about 29% of total revenue (Fig. 3).

Tappers working as hired labor under producers receive half of the total revenue from their product, less their subsistence advances paid by the producer during the production season. According to the tappers and producers interviewed, on average



a tapper can produce up to one tonne of frankincense per production season. However, the productivity of tappers is determined not only by their efficiency but also by the site condition, density and productivity of the tree in the production area. From the cost and revenue structure of the producers' (Table 4) the tappers' share of the total revenue is about 1,462 USD. This is the total revenue shared for four tappers working in a unit production area per season making the average gross annual income of a tapper about 360 USD. When the subsistence loan, about 290 USD/tapper, advanced by the producer is deducted the net cash income of a tapper is 74 USD in one production season which is about 6 USD/quintal of frankincense. Frankincense production is done during the dry season where there is no significant farming activity and there is less opportunity for job.

The main costs for village traders and other middlemen operating in rural markets are transportation cost, purchasing the product, and taxes and other local duties. Table 5 presents the cost and revenue of village traders who buy the commodity from the village and sell it to the El Rahad urban market. The analysis reveals that village traders gain an average net income of 8 USD/quintal. On average, one village trader handles 16 tonne off frankincense for the entire 5 months season. Taking the average annual sale of 16 ton per year, the average annual net income for a village trader was estimated to be 1,300 USD accounting about 10% profit margin (Table 5).

As described in the previous sections, urban merchants perform marketing and processing operations in the chain. They are backward integrated so that they produce frankincense through their agents making it extremely difficult to analyze the benefit of these actors. Thus, only their distribution and processing functions are considered in this analysis. On average urban merchants in El Rahad handle and process up to 90 tonne of frankincense per year. Thus, they gain an annual average net income of 11 USD from trading frankincense and its processing operations

**Table 5** The price structure of village traders

Average annual sales (ton)	16.00	
Cost items. price/income	USD/year	USD/quintal
Purchase of the product	8,471	54
Transportation	1,186	8
Labour	339	2
Store rent	121	1
Taxes and local duties	1,864	12
Informal fees (facilitation)	102	1
Subtotal	12,082	77
Gross revenue (sales = volume × selling price)	13,384	85
Profit margin	1,302	8
Profit margin (%)	10%	

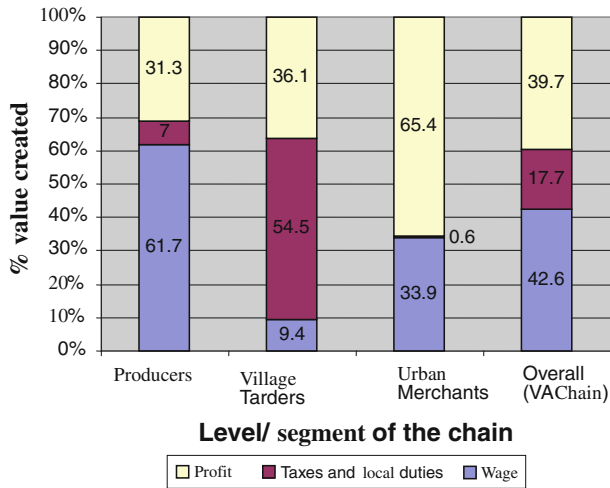
**Table 6** Urban merchants price structure

Average annual sales (tons)	90	
Cost items. price/income	USD/year	USD/Quintal
Purchase of the product	76,699	85
Transportation	6,159	8
Labour	5,825	7
Store rent	1,748	2
Taxes and local duties	109	0
Material	1,953	2
Handling loss 1%	767	1
Total cost	93,259	104
Product sales		
Product sales Grade 1	24,248	180
Product sales Grade 2	18,350	170
Product sales Grade 3	19,660	121
Product sales Grade 4 ( <i>Negawa, Ozala</i> )	27,087	100
Product sales Grade 5 ( <i>Gishra, scartu</i> )	13,204	86
Byproduct sales 1 ( <i>Turab</i> )	1,942	27
Gross revenue	104,490	
Profit margin	11,231	13
	10.70%	

(Table 6). This figure is equivalent to a profit margin of 6 USD from each kantar of unprocessed frankincense bought from village traders.

The processing activity is exclusively performed by female labor. It offers part-time jobs for many women in the city. 25–30 women work in one processing firm daily. Urban merchants estimate that 90 days are required to clean and grade one truck load (5–8 tonne) of frankincense. Similarly, females working in processing units indicate that a woman can clean and grade up to 80 kg of frankincense per day earning about 6 USD day<sup>-1</sup>.

Examination of the total value added in the commodity chain, considering only the segments up to the urban merchants, the highest value created is realized at production level (53.5%) indicating the limited value added processing in the other segments. The value added at the producers' level was estimated to be 48 USD/quintal. It is evident that the highest proportion (61.7%) of the value created is wage for tappers followed by the profit of the producer (31.3%) (Fig. 4). FNC, the locality office and the village together only account for 7% of the value added at the producers' level. The value added at village traders' level was estimated at 23 USD/quintal. From the distribution of the value added at this level of the chain, it is interesting to see that the large proportion (54.1%) of the value added accrued to the government in the form of taxes and local duties. This is an indicator for the concentration of taxes and local duties at the rural market level. About 36.1% of



**Fig. 4** Value added at different levels along the chain and its distribution

**Table 7** Commercialization margins of the chain (per quintal)

Actors	Average price (USD/quintal)		Commercialization margin	
	Purchase	Sale	USD	%
Producers		53		
Village traders	53	85	32	22.80
Urban merchants	85	116	31	21.90
Wholesaler	116	119	3	1.80
Domestic Retailers	119	141	22	16.00
			88	62.50
Total value			141	100.00

the value created goes to the village traders as a profit. At urban merchants' level, the largest proportion of the value added (65.4%) is accrued to the merchants as a profit. On the other hand very small proportion (<1%) goes to the government as taxes and other duties.

The analysis of the total relative commercialization/marketing margin shows that about 62.5% of the domestic consumers' price is captured by traders therefore the equivalent value received by those actors at the production level is about 37% (Table 7). Village traders' level is the main segment of the frankincense marketing chain, with 22.8% of its commercialization margin, followed by urban merchants (21.85%) and the group that comprises the retailers (16.3%). From this it can be seen that the market characteristics limit producers' share in the final price of the product.

**Table 8** Mechanisms of access maintenance and control in the frankincense commodity chain

FNC	Forest access control Law-based property right
Tribal leaders/ village	Forest access control Conventional customary right
Frankincense tappers	Maintenance of access to producers Social identity Working environment Tapping skill and experience
Producers	Control of access to labor opportunity and maintenance of access to tribal leaders Production license Access to capital/credit Social ties with tribal leaders Paying higher rent
Village traders	Maintenance of access to producers and urban merchants Credit arrangements (borrowing and lending) Social identity
Urban merchants	Maintenance of access to exporters and village traders Payment arrangements Credit arrangement (advance loan) Access to capital Social identity Knowledge of quality requirements by exporters Market information control

### Access to Benefits from the Frankincense Commodity Chain

The actors involved in the commodity chain of frankincense use different mechanisms to control and maintain benefits derived from the commercialization of the product. The FNC, tribal leaders, tappers, producers, urban merchants, wholesalers and exporters generate income or profit by different means of access maintenance and control. Commercial benefits in the frankincense commodity chain are derived from access to the resource, access to labor opportunity, and access to capital and market. A summary of the mechanisms of access maintenance and control used by the different actors along the commodity chain is presented in Table 8.

*Boswellia* woodlands are state property under the technical supervision of the FNC. The 1989 forest act, which is the amendment of the 1932 forest policy of the country, endorsed the FNC to supervise and manage national forests in Sudan. Thus, the FNC have low-based property right for *Boswellia* woodlands in the study area. The FNC have direct control over the resource and legal right-based access to the benefits from the resource. All users need a production permit/license from FNC to

secure or gain access. However, in order to avoid resource use conflicts, applicants for production license need to submit a signed agreement from tribal leaders along with their application.

Though tribal leaders do not have ownership rights, but have control over the direct access to the woodlands. This is due to their customary right to regulate the production of frankincense in terms of allocation of production areas in the village. Thus, they have recognized access rights and the ability to limit other people's access. Due to this customary property right, tribal leaders collect resource rent from producers for the use of the resource. For example, in Tomma village they charge rent up to 5 USD ha<sup>-1</sup>, depending on the productivity and accessibility of the production areas. The resource rent collected from frankincense producer is used for village development. Despite their control over direct access to the resource, the village benefits very little; it only receives 5% of the total revenue from frankincense production in the Tomma village (Fig. 2).

Producers gain access through production permits from the FNC. They do not have property rights, thus they have to gain or maintain access by paying fees. They also must establish a social relationship with tribal leaders and village traders. This enables them to access credit from village traders to pay for the licenses, resource rent and initial investment for production, such as advance subsistence loans, supply production materials and other operating costs. Anyone can apply for production licenses from the FNC. However, only those who have a signed agreement from tribal leaders will get the license. Tribal leaders give priority to those producers who have the ability to pay high rent amounts. This creates a barrier for the local community to apply for a production license. Thus, producers secure access by paying more resource rent and dispensing some of their revenue in the village development. In summary, producers have access to capital in the form of credit to buy resource access control through the purchase of licenses and maintain resource access by paying rent and influencing tribal leaders.

Frankincense tappers have limited access to credit, and thus capital, to obtain permits for resource access. However, they are able to acquire some of the benefits derived from frankincense production in the study area. They use this labor opportunity to gain access to the resource and the benefit from frankincense production. Access to labor opportunity includes the ability to maintain access to employment with others (Ribot and Peluso 2003). Migrant frankincense tappers have more labor opportunities than locals because of their experience and tapping skills. In this case, access to knowledge is used to maintain their labor opportunity and access to benefit. In addition, tappers gain access to benefit through producers who control labor opportunity. Due to their social identity, Bani-Amirs have a greater opportunity for employment as most of the producers are also Bani-Amirs. Moreover, the hardship and hostile working environment associated with tapping work also limits the participation of the locals. This barrier helps migrant tappers to maintain access to labor opportunities.

Village traders have access to market and market information. Collection and distribution of frankincense at rural markets needs moderate financial capital to pay taxes and other local duties as well as purchase of the product (Table 8). Village traders and middlemen have access to capital in the form of credit from urban

merchants. In most cases, traders borrow money for producers so that the producers have to sell their products to them. They also have social ties to producers and urban merchants, as a result of their social identity.

Urban merchants have access to capital, technology, and knowledge about exporters' quality requirements because of their access to exporters and their agents. Relatively higher capital is invested at the urban merchants' level for processing materials and purchasing the product in bulk quantity. Urban merchants use credit arrangement mechanisms and strong social ties with village traders to maintain their access to benefit.

### **Concluding Remarks**

Frankincense production and marketing is financially profitable for producers, village traders and urban merchants. However, the upward skewed benefit distribution implies that frankincense tappers and producers receive less income in spite of their efforts and role in the production of the product. There may be opportunities to increase prices for producers and tappers, but it must be recognized that downstream actors bear relatively higher levels of risk due to capital investment and fluctuating markets. If the tappers were able to get credit facilities for the initial investment in frankincense production, their income would be increased tremendously.

Locally, value added processing has a high potential for increasing the benefits of the local actors, reducing transportation cost, and ensuring the involvement and benefit of women from the commercialization of frankincense. However, value addition, in the form of primary processing at the production level, is limited due to a lack of awareness, limited financial resources and capital, and market knowledge about quality requirements. At the national level, opportunities also lie in promoting value adding in the country through the establishing of medium-sized processing plants (steam distillation or extraction plants) that will result in the export of semi-processed and/or processed essential oils/resinoids, which fetch better prices.

### **Recommendations**

There are a number of areas in which local actors, tappers and producers, can be empowered to improve their income from commercialization of frankincense. Based on the results of this study recommendations are drawn to improve the efficiency of the whole value chain with special emphasis on upstream actors. Offering credit facilities may enable the local community to get production permit to produce and sell their products themselves instead of depending on outsiders and hence improve their income. Training on production, processing and marketing and organization of actors could boost the technical and marketing skills, marketing power, and price negotiation resulted from the economies of scale that reduce transaction costs. Improvement of marketing information is a crucial intervention area for upstream actors that suffer from inadequate knowledge and incomplete

information about products quality standards, markets and prices. From the perspective of conserving the resource base and sustaining the extraction of the product, supervision of production areas to combat improper and intensive tapping is essential. Finally, encouraging value added processing activities including primary processing like cleaning, drying, grading, at the local level could create employment opportunities, especially for women, and enable to retain more benefits at the community level. Further studies in analyzing the commodity chain considering the export segment and industrial processing in importing countries is recommended to give a clear picture of the global commodity chain. This study mainly examines the commodity chain originating in the case study area till the central market. Thus, comparative studies are also recommended to examine other chains and to find out best practices and lessons.

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